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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte TOMIO SUGIYAMA

Appeal 2008-6213
Application 09/873,287
Technology Center 1700

Decided:[1] February 4, 2009

Before EDWARD C. KIMLIN, ADRIENE LEPIANE HANLON, and LINDA M. GAUDETTE, *Administrative Patent Judges*.

HANLON, *Administrative Patent Judge*.

DECISION ON APPEAL

A. STATEMENT OF THE CASE

[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the decided date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

This is an appeal under 35 U.S.C. § 134 from an Examiner's decision rejecting claims 1-6 and 14, all of the claims pending in the application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

The following Examiner's rejections are before us for review:

(1) Claims 1, 2, 4-6, and 14 are rejected under 35 U.S.C. § 103(a) as unpatentable over Tatumoto[2] in view of either Kobayashi[3] or Nanataki[4] with evidence from page 5, lines 5-17 of the Appellant's Specification or Fujishiro.[5]

(2) Claim 3 is rejected under 35 U.S.C. § 103(a) as unpatentable over Tatumoto in view of either Kobayashi or Nanataki and further in view of Ishiguro.[6]

(3) Claim 5 is rejected under 35 U.S.C. § 103(a) as unpatentable over Tatumoto in view of Kobayashi and Nanataki and further in view of JP 409.[7]

(4) Claim 6 is rejected under 35 U.S.C. § 103(a) as unpatentable over Tatumoto in view of Kobayashi and Nanataki and further in view of JP 571.[8]

The subject matter on appeal relates to a multilayered gas sensing element. Claim 1, the only independent claim on appeal, is representative of the subject matter on appeal and reads as follows:

> 1. A multilayered gas sensing element for incorporation into a gas sensor installed in an exhaust system of an internal

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[2] US 5,522,979 issued June 4, 1996 to Tatumoto et al.
[3] US 4,961,835 issued October 9, 1990 to Kobayashi et al.
[4] US 5,419,827 issued May 30, 1995 to Nanataki et al.
[5] US 4,105,524 issued August 8, 1978 to Fujishiro et al.
[6] US 4,851,105 issued July 25, 1989 to Ishiguro et al.
[7] JP 9-26409 published January 28, 1997.
[8] JP 08-114571 published May 7, 1996.

combustion engine, the multilayered gas sensing element comprising:

laminated layers comprising at least one solid electrolytic sheet containing zirconia and yttria and at least one insulating sheet containing alumina;

a crystal phase containing silicon dioxide which intervenes between said solid electrolytic sheet and said insulating sheet at least at a part of a bonding boundary between said solid electrolytic sheet and said insulating sheet; and

a heater directly attached to a side surface of said insulating sheet to transfer heat generated in said heater to said insulating sheet and said solid electrolytic sheet,

wherein said solid electrolytic sheet and said insulating sheet having said heater are laminated and sintered such that the crystal phase is liquefied during the sintering so as to generate material transfer between said sheets via the liquefied crystal phase and such that the material transfer causes said sheets to be integrally bonded with each other.

Br. 13, Claims Appendix.[9]

B. ISSUE

As for rejection (1), the Appellant argues the patentability of claims 1, 2, 4-6, and 14 as a group. Thus, as to rejection (1), we decide the appeal on the basis of independent claim 1. *See* 37 C.F.R. § 41.37(c)(1)(vii) (2007). The Appellant does not address the remaining rejections, i.e., rejections (2), (3), and (4), separately. Br. 12. We have separately considered these grounds of rejection based on the arguments advanced in support of the patentability of claim 1.

The sole issue on appeal is:

[9] Corrected Appeal Brief dated May 10, 2007.

Has the Appellant shown that the Examiner reversibly erred in concluding that the combined teachings of Tatumoto, Kobayashi, Nanataki, Fujishiro, and page 5, lines 5-17 of the Appellant's Specification would have rendered obvious "a crystal phase containing silicon dioxide which intervenes between said solid electrolytic sheet and said insulating sheet" as recited in claim 1?

C. FINDINGS OF FACT

The following findings of fact are supported by a preponderance of the evidence. Additional findings of fact as necessary appear in the Analysis portion of the opinion.

1. Appellant's Specification

The Appellant discloses a multilayered gas sensing element comprising a zirconia-series solid electrolytic sheet, an alumina-series insulating sheet, and a bonding boundary intervening between the zirconia-series sheet and the alumina-series sheet.[10] The bonding boundary includes a crystal phase containing silicon dioxide (SiO_2). Spec. 2:20-26.

The Appellant also discloses a method for manufacturing the multilayered gas sensing element:

> [T]he present invention provides a first method for manufacturing a multilayered gas sensing element comprising the steps of preparing a zirconia-series green sheet containing SiO2 [sic, SiO_2] and aluminum oxide (Al2O3 [sic, Al_2O_3]) for forming a solid electrolytic sheet, preparing an alumina-series green sheet for forming an insulating sheet, bonding the zirconia-series green sheet and the alumina-series green sheet to

[10] The terms "zirconia" and "zirconium oxide," as well as the terms "alumina" and "aluminum oxide," are used interchangeably in this opinion. Likewise, the terms "yttria" and "yttrium oxide" are used interchangeably in this opinion.

> constitute an unburnt laminated body, and sintering the unburnt laminated body.
>
> According to the first manufacturing method of the present invention, the liquefied phase appears during the sintering operation at a region where a zirconia grain and an alumina grain contact with each other. The liquefied phase chiefly contains SiO2 [sic, SiO_2] which has melted into this liquefied phase from the zirconia-series green sheet during the sintering operation of the laminated green sheets.

Spec. 5:5-17.

The components constituting the liquefied phase can function as a binder as they harden in a cooling process following the sintering operation. Spec. 5:19-21.

In a preferred embodiment, the bonded laminated body is sintered or baked at a temperature of 1,500° C. Spec. 14:28-30.

Another method for manufacturing the disclosed multilayered gas sensing element includes applying a paste containing silicon dioxide on the zirconia-series green sheet and the alumina-series green sheet. The two green sheets are bonded at the surfaces on which the paste is applied, and then sintered together. Spec. 9:13-17.

2. Tatumoto

Tatumoto discloses an oxygen sensor comprising a solid electrolyte and an alumina porous layer formed on a surface of the solid electrolyte. Tatumoto 7:44-50.

The solid electrolyte is partially stabilized zirconia of Y_2O_3-ZrO_2 series. Tatumoto 7:60-61.

Tatumoto discloses a method for fabricating the oxygen sensor wherein the sheet for the alumina porous layer is laminated to the surface of

the sheet for the solid electrolyte and simultaneously baked at a temperature of 1,470° C. Tatumoto 8:56-64.

Tatumoto discloses that a preferred baking temperature is within a range of 1,400° to 1,500° C. Tatumoto 6:66-7:8.

3. Kobayashi

Kobayashi discloses a solid electrolytic substance that is capable of being used to form an oxygen sensor. Kobayashi 2:38-43.

In particular, Kobayashi discloses a solid electrolytic substance comprising yttrium oxide (Y_2O_3), silicon dioxide (SiO_2), and zirconium oxide (ZrO_2). Kobayashi 2:44-53.

Kobayashi discloses that the thermal expansion coefficient of the solid electrolytic substance is close to that of non-electrolytic ceramics, such as alumina. Kobayashi 2:54-57, 4:3-5.

Kobayashi discloses that the life characteristics of an oxygen sensor are improved when the thermal expansion coefficient of the solid electrolytic substance and those of the ceramic and the adhesives used in the oxygen sensor are matched. Kobayashi 4:40-43.

4. Nanataki

Nanataki discloses partially stabilized zirconia containing yttrium oxide in combination with an MgO, an Al_2O_3, and a SiO_2 ingredient. Nanataki 3:15-19.

Nanataki discloses that the partially stabilized zirconia has excellent thermal shock resistance. Nanataki 3:19-21.

5. Fujishiro

Fujishiro discloses an oxygen sensor comprising an electrolyte layer. Fujishiro 3:54-59.

Fujishiro discloses that the electrolyte material may be ZrO_2-CaO or any of the known solid electrolytes in which oxygen ions function as the electron carriers. Fujishiro 3:59-64.

Fujishiro discloses that the electrolyte material is hermetically sealed to conductor members in the sensor. Fujishiro 4:32-34.

According to Fujishiro, the adhesion strength of the hermetic seal can be enhanced by using a solid electrolyte material that contains a minor amount of SiO_2 and/or Al_2O_3. These minor oxide amounts are present in the resulting ceramics as a secondary phase distinct from the solid solution phase of ZrO_2-CaO and exhibit strong affinity for metallic coatings. Fujishiro 5:16-24.

Fujishiro discloses that the electrolyte material is baked at a temperature of about 1,200° to about 1,600° C. Fujishiro 5:12-16.

D. PRINCIPLES OF LAW

A claimed invention is not patentable if the subject matter of the invention would have been obvious to a person having ordinary skill in the art at the time the invention was made. 35 U.S.C. § 103(a); *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007); *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 13 (1966).

Facts relevant to a determination of obviousness include (1) the scope and content of the prior art, (2) any differences between the claimed invention and the prior art, (3) the level of skill in the art, and (4) any relevant objective evidence of obviousness or non-obviousness. *KSR*, 127 S. Ct. at 1734; *Graham*, 383 U.S. at 17-18.

A person of ordinary skill is not an automaton but is a person of ordinary creativity. *KSR*, 127 S. Ct. at 1742. One of ordinary skill in the art is presumed to have skills apart from what the prior art references expressly disclose. *In re Sovish*, 769 F.2d 738, 742 (Fed. Cir. 1985).

The test for obviousness is not that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to one of ordinary skill in the art. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981).

E. ANALYSIS

The Examiner found that Tatumoto discloses a solid electrolyte sheet containing zirconia and yttria and an insulating sheet containing alumina. The Examiner found that the solid electrolyte sheet and the insulating sheet are laminated and sintered to be integrally bonded to each other. The Examiner also found that Tatumoto does not expressly disclose that the solid electrolyte contains silicon dioxide. Ans. 3.[11]

Nonetheless, the Examiner found that Kobayashi teaches that it is desirable to add silicon dioxide to a solid electrolyte comprising zirconia and yttria. Likewise, the Examiner found that Nanataki teaches that it is desirable to add silicon dioxide to a partially stabilized zirconia which contains yttria. The Examiner concluded that it would have been obvious to one of ordinary skill in the art to add silicon dioxide to the Y_2O_3-ZrO_2 solid electrolyte of Tatumoto in view of the teachings in Kobayashi and/or Nanataki. Ans. 3-4.

Claim 1 recites that a crystal phase containing silicon dioxide intervenes between the solid electrolyte sheet and the insulating sheet.

[11] Examiner's Answer dated August 20, 2007.

The Examiner relied on page 5, lines 5-17 of the Appellant's Specification, as well as Fujishiro, to establish that it was known in the art that silicon dioxide forms a phase on the surface of a solid electrolyte upon baking that is distinct from the solid electrolyte phase. Thus, the Examiner found that adding silicon dioxide to the solid electrolyte of Tatumoto, followed by sintering at the disclosed temperature, would necessarily result in the crystal phase recited in claim 1. Ans. 4, 7-8; *see also* Tatumoto 6:66-7:8 (disclosing a preferred baking temperature within a range of 1,400° to 1,500° C).

The Appellant does not point to any error in the Examiner's factual findings or the Examiner's conclusion that it would have been obvious to one of ordinary skill in the art to add silicon dioxide to the Y_2O_3-ZrO_2 solid electrolyte of Tatumoto in view of the teachings in Kobayashi and/or Nanataki. Rather, the Appellant focuses on Fujishiro and argues that Fujishiro does not teach or suggest (1) incorporating silicon dioxide in ceramic sheets containing zirconia and yttria, (2) material transfer between ceramic sheets via the liquefied crystal phase, and (3) a crystal phase containing silicon dioxide. Br. 11.

The Appellant's arguments are not persuasive of reversible error. As to item (1), the Examiner relied on the teachings of Kobayashi and Nanataki, not Fujishiro, to establish that it would have been obvious to one of ordinary skill in the art to add silicon dioxide to the Y_2O_3-ZrO_2 solid electrolyte of Tatumoto. *Keller*, 642 F.2d at 425.

As to item (3), the Examiner found that Fujishiro is cumulative of the teachings in the Appellant's Specification (i.e., page 5, lines 5-17) that the formation of a silicon dioxide crystal phase is the phenomenological result

of adding silicon dioxide to the solid electrolyte. Ans. 7-8, 9. In particular, the Examiner found that Fujishiro discloses that silicon dioxide forms a "secondary phase distinct from the solid solution phase of ZrO_2-CaO" upon baking at a temperature of about 1,200° to 1,600° C. Ans. 4; Fujishiro 5:12-24.

Based on the teachings in the Appellant's Specification and Fujishiro, the Examiner found that adding silicon dioxide to the solid electrolyte of Tatumoto, as suggested by Kobayashi and Nanataki, followed by sintering at a temperature within the disclosed range of 1,400° to 1,500° C would have been expected to result in the crystal phase recited in claim 1. Ans. 4, 7-8; *see also* Spec. 14:28-30 (disclosing a preferred sintering temperature of 1,500° C.). The Appellant has failed to point to any error in the Examiner's findings.

As to item (2), the Examiner found that material transfer via the liquefied crystal phase formed during sintering is also a phenomenological result of adding silicon dioxide to the electrolyte. *See* Spec., 5:12-17. Thus, the Examiner found that adding silicon dioxide to the solid electrolyte of Tatumoto followed by sintering within the disclosed range would have been expected to result in material transfer as recited in claim 1. Ans. 5. Again, the Appellant has failed to point to any error in the Examiner's findings.

In another attempt to distinguish Fujishiro from the claimed subject matter, the Appellant argues that Fujishiro applies silicon dioxide as a paste on the surface of the ceramic in contrast to the Appellant's invention where silicon dioxide is contained in the ceramic sheet(s). Br. 11.

The claims on appeal do not exclude the use of a paste containing silicon dioxide. Indeed, the Appellant expressly discloses that a paste

containing silicon dioxide may be used to bond zirconia and alumina sheets to each other. Spec. 9:13-17.

Finally, the Appellant argues that the cited prior art does not provide any teaching or suggestion that incorporating silicon dioxide will strengthen a bond between adjacent ceramic sheets. Br. 11.

In this case, the Examiner has provided sufficient reasons to combine the teachings of the prior art, i.e., to adjust the thermal expansion coefficient of the solid electrolyte and to increase the thermal shock resistance of the electrolyte. *See In re Kemps*, 97 F.3d 1427, 1430 (Fed. Cir. 1996) ("the motivation in the prior art to combine the references does not have to be identical to that of the applicant to establish obviousness"). Thus, absent evidence that silicon dioxide unexpectedly strengthens a bond between adjacent ceramic sheets, the Appellant has failed to rebut the *prima facie* case of obviousness. *See In re Dillon*, 919 F.2d 688, 693 (Fed. Cir. 1990) ("the discovery that a claimed composition possesses a property not disclosed for the prior art subject matter, does not by itself defeat a *prima facie* case").

F. CONCLUSIONS OF LAW

The Appellant has not shown that the Examiner reversibly erred in concluding that the combined teachings of Tatumoto, Kobayashi, Nanataki, Fujishiro, and page 5, lines 5-17 of the Appellant's Specification, would have rendered obvious "a crystal phase containing silicon dioxide which intervenes between said solid electrolytic sheet and said insulating sheet" as recited in claim 1.

G. DECISION

The decision of the Examiner is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a) (2008).

AFFIRMED

PL Initial:
sld

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